



The Water Report™

Water Rights, Water Quality & Water Solutions in the West

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YAKIMA RIVER BASIN INTEGRATED PLAN

IMPLEMENTING BASIN-SCALE WATER MANAGEMENT & CLIMATE ADAPTATION

by Steve Malloch, Western Water Futures, LLC and Michael Garrity, American Rivers

Editors' Introduction: At the direction of the Washington State Legislature, a *Benefit-Cost Analysis of the Yakima Basin Integrated Plan Projects* was released on December 15, 2014. Some supporters of the Yakima Basin Integrated Plan took exception to some of the report's findings. What follows are articles and responses by two of the Plan's supporters and the principal author of the B-C Analysis — minimally edited to match *The Water Report's* usual format.

INTRODUCTION

Climate adaptation and ecosystem restoration do not always fit easily in the same approach in the water world — in a warming world, competition for already scarce resources may make restoration even more difficult in many parts of the West. In the Yakima River Basin of eastern Washington, an unusual set of actors have put aside longstanding differences to engage in a serious and complex effort to restore hundreds of thousands of salmon to a basin where they were all but extirpated while at the same time providing improved reliability of water supplies for irrigated agriculture, cities, and domestic use. This effort is not without controversy, as it will take decades to complete, be expensive, and rely on tradeoffs that not all embrace.

The Yakima Basin Integrated Plan was previously described by the authors in *The Water Report* #106 (December 15, 2012), which was followed by a reply from opponents and a rebuttal by the authors in *The Water Report* #108. [Editors' note: past issues of *The Water Report* are available in electronic format (PDF) to subscribers upon request: TheWaterReport@yahoo.com].

This article will briefly summarize the Yakima Basin Integrated Plan, provide updates on the status of plan, and respond to a recent economic analysis of the plan.

BACKGROUND

THE YAKIMA RIVER BASIN

Washington's Yakima River is located on the arid east side of the state, nestled between the Cascade Mountain crest and the Columbia River. Water development in the basin has worked spectacularly well to grow crops and the Yakima basin's agricultural economy. In the 6,155 square mile basin, there are about 500,000 acres of irrigated land supporting an agricultural economy valued at \$3.4 billion. Average annual water supply is about 3.3 million acre-feet, with deliveries of about 1.7 million acre-feet. Notable crops include apples, sweet cherries, most of the hops grown in the U.S. and increasingly well regarded wine grapes, along with vegetables, stone fruit, dairies, cattle, timothy hay exported to feed exotic horses, and a variety of other crops.

Yakima Basin Plan

Phased Development

Development Costs

Reliable Supply

Water development proceeded in phases. Early private and small cooperative irrigation works gave way to larger and railroad financed projects in the late 1800's. By the turn of the century, natural flow water rights (as opposed to storage rights) fully consumed the rivers. Bigger projects were needed, including water storage. In 1905, the Yakima Project — one of the earliest US Bureau of Reclamation (Reclamation) projects — was authorized. The Yakima Project claimed all remaining unappropriated water in the basin, and included five main storage reservoirs and hundreds of miles of canals. Reclamation water contractors who depend on the federal supply occupy a uniformly junior position in the basin's water rights hierarchy.

That development had a high cost. Pre-settlement salmon runs in the basin are estimated to have ranged from 360,000 to 900,000 annually, and were the source of much of the food for Native Americans. As irrigation works were built, damming and diverting the basin's water, salmon numbers plummeted. Sockeye, summer Chinook and coho were extirpated. Steelhead and bull trout were listed under the federal Endangered Species Act in the late 1990s. A treaty signed with the Confederated Tribes and Bands of the Yakama Nation in 1859 reserved to the Yakama the right to hunt and fish. Reclamation's Yakima Project sealed the fishery's doom by constructing large reservoirs without fish passage. By the 1980s as few as 8,000 salmon returned. The treaty right remained intact, but there weren't fish to catch.

The benefit of that water infrastructure development, of course, was a much more reliable water supply. With the Reclamation project, modest reservoir storage of about 30% annual runoff combined with the upper Yakima basin's remarkably consistent and deep winter snowpack, made drought and serious water shortage rare.

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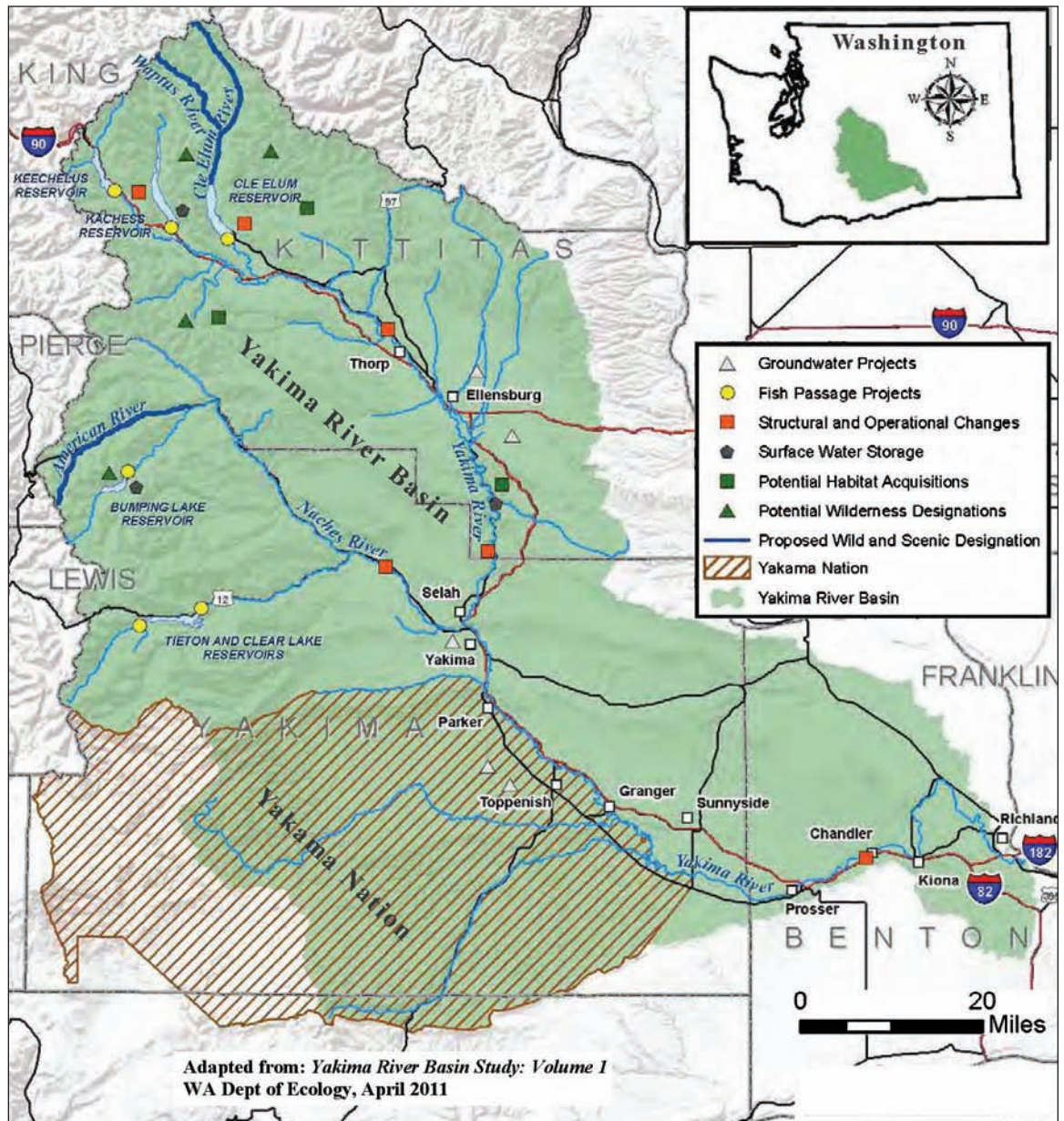
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Adapted from: *Yakima River Basin Study: Volume 1*
WA Dept of Ecology, April 2011

Yakima Basin Plan

Water Enhancement Legislation

Climate Concerns

Alternatives Studied

Addressing Supply Issues & Ecosystem Restoration

Basin Plan Elements

As in many places in the west, drought spurs interest in changes to the water-infrastructure status quo. The great west-wide 1977 drought prompted the Yakima River Basin Water Enhancement Project (YRBWEP I) in 1979 and 1984 — federal legislation which focused on fish screens and passage. Subsequent droughts in the 1990's prompted a second phase of federal legislation in 1994, YRBWEP II, which focused on water conservation and efficiency, along with habitat restoration and acquisition. Yakima basin interests have long envisioned a Phase III that would include new or expanded reservoir storage. In 2003, Congress authorized a feasibility study of a massive project that would divert and pump Columbia River water into the basin, and store it in a massive off-stream reservoir. The Black Rock project stalled in 2008 when analysis found it returned 13 cents on the dollar of investment, and had serious potential to speed movement of radioactive waste from the decommissioned Hanford nuclear production Superfund site towards the Columbia River.

Climate scientists at the University of Washington and elsewhere identified the Yakima basin as significantly sensitive to loss of snowpack, both because the low to mid-elevation snowpack is sensitive to climate change and because of the relatively low ratio of reservoir storage to annual water use in the basin. This year (2015) demonstrates the concern. Precipitation fell mostly as rain which filled the reservoirs to capacity, but snowpack was only 12 percent of normal on April 1 in the Yakima basin. The result is Reclamation's forecast of a 60% water supply for its contractors. The full reservoirs cannot make up for the storage provided by the historically reliable snowpack. This is exactly the scenario forecasted by most climate models. Climate concerns, coupled with this history of faltering fisheries and wilted water projects, prompted the need for a new approach.

YAKIMA BASIN INTEGRATED PLAN

As the fate of the Black Rock Project became apparent and prompted by the need for a broader set of alternatives under Washington State's Environmental Policy Act, the State's Department of Ecology (Ecology) began exploring alternatives that would respond to signals of openness to flexibility from the water and fishery powerhouses in the basin, the Yakama Nation and the Roza Irrigation District. In an Environmental Impact Statement (EIS) for Black Rock, Ecology laid out the outlines of what would become, after several years of process and a basin study under the federal SECURE Water Act of 2009, the Yakima Basin Integrated Plan (YBIP). In July, 2013, Reclamation issued a Record of Decision on a programmatic EIS for YBIP.

At its heart, YBIP is a set of pragmatic actions that address the major water supply issues and ecosystem restoration of the basin through seven integrated elements that are envisioned to be completed over the next 30 years in a way that carefully orchestrates improving the position of each of the major interests in a balanced fashion.

BRIEFLY, PRIMARY YBIP ELEMENTS INCLUDE:

- **FISH PASSAGE AT ALL SIX OF THE RECLAMATION RESERVOIRS:** None of the Reclamation reservoirs included fish passage when built between 1910 and 1933. Sockeye stand to benefit most from fish passage, because they relied upon glacial lakes that were inundated by building of the dams, although other anadromous and resident fish species, including bull trout, are anticipated to greatly benefit from access to good quality habitat on public lands in the higher elevation, cold water areas above the dams.
- **MODIFICATION TO MAKE BETTER USE OF EXISTING FACILITIES:** These changes include reducing water diversions for hydropower; raising Cle Elum Reservoir by 3 feet; and building a new water conveyance tunnel to make better use of existing reservoir capacity while reducing flows harmful to juvenile salmon rearing.
- **INCREASED SURFACE WATER STORAGE FOR BOTH WATER SUPPLY AND FISHERIES:** These projects range from expensive to very expensive. Most economical is tapping inactive storage in Kachess Reservoir below the reservoir outlet so that up to 200,000 acre-feet of water could be used for drought relief. Expansion of Bumping Reservoir by building a new dam downstream is more expensive, and would yield an additional 165,500 acre feet; this project is controversial because it would inundate about 980 acres of old-growth forest, bull trout spawning habitat, and homes on leased US Forest Service land occupied by vocal critics. The most expensive project is construction of Wymer Reservoir, a new off-stream, pumped-storage reservoir in the lower Yakima River canyon. Reclamation and Ecology are looking at alternatives to reduce the size and cost of this project.
- **GROUNDWATER STORAGE:** Groundwater storage envisioned includes both pumped aquifer storage and recovery, and selective surface infiltration ponds where hydrogeology allows.
- **HABITAT PROTECTION AND ENHANCEMENT:** In addition to significant habitat acquisition and restoration in the basin's rivers, streams, and floodplains, YBIP included acquisition of 15,000 acres of shrub steppe, 45,000 acres of private forest lands in the tributary Teanaway River basin, and 10,000 acres of private lands interspersed ("checkerboarded") within the boundaries of National Forests.
- **ENHANCED WATER CONSERVATION:** A major target was conserving up to 170,000 acre-feet annually in wet years by reduction in conveyance and operational losses through lining and piping canals and ditches, and application efficiency. While conservation does not "make new water" and works only when water is available, conservation does allow water to be managed much more effectively, and when water is available, will increase flows for fish.

Yakima Basin Plan

Fish Returns & Water Delivery

Integrated Approach

Initial Results

Legislation & Funding

Land Purchases

Environmental Review

• **MARKET REALLOCATION OF WATER:** Effective water marketing is a bedrock element of YBIP, but one that is a work in progress. Initially the effort will be to make the existing mechanisms more effective. In the process, we anticipate that changes to laws, policies and institutions will be needed to make markets work effectively and comprehensively. Largely because markets did not provide significant relief to junior water rights holders in prior droughts, water districts are reluctant to rely heavily on water markets in future droughts.

Goals for YBIP are high. On the fishery side, current annual salmon returns are in the range of 25-40,000 fish; the goal is to expand that tenfold. On the water side, the goal is to have significant water deliveries to the junior, Reclamation water rights in even the dry years of record, as well as increase supplies for municipal, industrial, and domestic use.

The difference between traditional water projects and YBIP is integration and scale — the pieces are intended to work together to address: improved use of water; improved water supply reliability; adaptation to anticipated effects of climate change; meaningful fishery restoration that bring stocks back to a substantial portion of historic runs; and land conservation that supports both the water supply and fishery goals.

For the environment, the main shift in thinking was in taking on fishery issues — but not as “mitigation” for additional harm arising from water infrastructure development, and not in a simplistic “dams for the environment” fashion. Instead, during the YBIP formulation process, stakeholders asked the question “what do we need to do to have sustainable fisheries in the basin?” The answer started with fish passage to allow fish access to high elevation, cold-water habitat above the dams. Beyond that, YBIP looked to achieve multiple objectives by improving floodplain habitat while also serving to reduce flood risk to humans by setting back levees and opening side channels. Further, when looking at ESA-listed steelhead, YBIP addressed the problem of the need for additional habitat by proposing to acquire a 45,000 parcel of commercial forest lands that includes prime potential steelhead habitat. Linking upland state and federal forest management to water supply reliability and fishery restoration is central to the YBIP approach.

YBIP: Present Status & Results to Date

Since the December 2012 YBIP article in *The Water Report*, rapid progress has been being made towards implementation, with funding, planning, process, and early action items.

INCLUDED AMONG THE MOST SIGNIFICANT OF THE RESULTS ARE:

2013 STATE LEGISLATION: YBIP started 2013 as the first legislative priority rolled out by newly-elected Governor Jay Inslee. That strong support from the Governor was reflected in a \$21 million budget request to the legislature for furthering YBIP, which included funding for a down payment for land acquisition. When the owner of the first target for acquisition — with land in the Teanaway River tributary to the Yakima — decided it was willing to sell its entire 50,000 acre holding for \$100 million, funding for the Yakima project, and the Teanaway acquisition, became the political pivot for the entire biennial state capital budget in a tight budget year. To the astonishment of most observers, the Republican majority in the Senate was willing to buy the entire Teanaway in one transaction rather than over a decade (as had been envisioned). The result was YBIP-related funding of \$137 million.

TEANAWAY PURCHASE AND COMMUNITY FOREST: With funding in hand, the Teanaway acquisition, originally slated for 45,000 acres, became a 50,000 acre closed deal by the end of 2013. The legislature decided to enroll the Teanaway lands in a new status — “Community Forest” — jointly managed by the State’s Department of Natural Resources and the Department of Fish and Wildlife for multiple purposes, consistent with the YBIP goals. Setting up management goals and processes of the Teanaway Community Forest is ongoing. In addition, the federal government purchased 4,000 acres of formerly privately held “checkerboard” forest lands in the upper Yakima thanks to a Land and Water Conservation Fund allocation tied to the YBIP. The rest of the checkerboard in the upper Yakima was purchased in 2014 by The Nature Conservancy (TNC) in a transaction that occurred outside the auspices of the YBIP. The net result is that between YBIP and TNC, development threats to lands in the upper watersheds of the Yakima Basin are averted, and conservation and sustainable management of those lands can now be undertaken.

NEPA AND SEPA PROCESSES: As a joint federal and state project, YBIP is subject to both state and federal environmental review processes. In July 2013, Reclamation issued a Record of Decision on the programmatic EIS for YBIP; despite vocal opposition, especially to the reservoir elements of the plan, to date, no litigation followed. In September 2014, Reclamation released a draft EIS on raising the pool of Cle Elum Reservoir by three feet. In January 2015, Reclamation released a draft EIS for the first really large water infrastructure projects, accessing 200,000 acre-feet of water in inactive storage through the Kachess Drought Relief Pumping Plant (KDRP) and the Keechelus to Kachess Conveyance (K2K) that serves to reduce high flows harmful to juvenile salmon rearing in the upper Yakima River and to help refill Kachess when water in inactive storage is used.

Yakima Basin Plan

Fish Passage

Draft Federal Legislation

Legislation Elements

Major Projects

Additional Purposes

Users' Repayment Terms

FISH AND FISH PASSAGE AT LAKE CLE ELUM: The Yakama Nation’s fishery program began trapping sockeye from other parts of the Columbia River system and hauling them to Lake Cle Elum in 2009. In the fall of 2013 the first sockeye hatched in the Cle Elum system returned, heralding a system that will soon be reborn. In 2014, 2,600 naturally spawned sockeye returned, more than replacing the 2,500 salmon that spawned them in 2010. With the fish in the system and successfully returning, it is now up to Reclamation to build facilities to allow the fish to do what comes naturally.

After years of work, engineers at Reclamation’s Denver Office have developed a successful design for downstream passage of juvenile salmon at Lake Cle Elum. Downstream passage is complicated in a reservoir used for water supply because migrating juvenile salmon move in the upper couple of feet of the water column — while the outlet of most dams is much deeper. No really successful downstream passage design had been developed for reservoirs where the water level changes so significantly. Following many attempts at multi-level inlet passage designs, which had unacceptable transport water velocity and turbulence that could harm fish, Reclamation has finally created a design that works in scale models. Engineering of the full-scale project is in progress and construction on the upstream adult fish passage system is scheduled for later this year.

FEDERAL LEGISLATION AND INITIAL DEVELOPMENT PHASE OF YBIP: Stakeholders spent significant time in 2014 negotiating terms for draft federal legislation. Despite years of working together, negotiating proposed federal legislation among the many stakeholders possessing strong and divergent interests could have riven the cohesion of the project proponents. It did not. In early 2015, draft legislation was delivered to Senator Maria Cantwell for her consideration. While the draft is not public at the time of this writing, significant elements of the agreement it embodied have been released.

AMONG THE DRAFT LEGISLATION’S SIGNIFICANT ELEMENTS ARE THE FOLLOWING:

AUTHORIZATION OF THE INITIAL DEVELOPMENT PHASE MAJOR PROJECTS: One of the criticisms of YBIP is that it is a 30+ year \$4 billion project — too big and too expensive for these times. While no one thought all of YBIP would be implemented quickly, there were implicit priorities. However, only a preliminary implementation schedule was included in YBIP documents, and no formal phasing was proposed. In the draft legislation, the large projects of an initial development phase are laid out, as well as progress to be achieved during the first phase of implementing YBIP’s programmatic elements. In addition to otherwise authorized projects (such as the Cle Elum pool raise and fish passage, water marketing, and habitat projects) this initial phase includes:

- **KACHESS DROUGHT RELIEF PUMPING PLANT (KDRPP):** Making better use of existing infrastructure was a priority for YBIP, so gaining access to 200,000 acre-feet of water in inactive storage, which is the most cost effective of the supply project, was both a policy and an economic priority. This project also does not have the impact of inundating new land. A draft EIS has been released (*see* www.usbr.gov/pn/programs/eis/kkc/kcdeis.pdf).
- **KECHELUS TO KACHESS CONVEYANCE:** The “K2K” conveyance was initially envisioned as primarily a water supply option that helped to refill Kachess after drawdown from KDRPP. Refined engineering found the primary benefit of the project is to reduce flows in the upper Yakima River, which improves salmon spawning habitat, with secondary water supply benefit. A draft EIS has been released (*see* www.usbr.gov/pn/programs/eis/kkc/kcdeis.pdf).
- **CONSERVATION PROJECTS:** These include continued water conservation and efficiency projects that would yield 85,000 acre-feet of water, or half the YBIP’s 30-year target in ten years.
- **FISH PASSAGE AT A SECOND RECLAMATION RESERVOIR:** The most obvious target for a second fish passage facility is Rimrock Reservoir on the Tieton River because there is more habitat upstream of the dam than at any other reservoir. As with fish passage for Cle Elum, downstream passage is a technical challenge due to fluctuating reservoir levels so the Cle Elum engineering breakthrough may make the project possible.
- **GROUNDWATER RECHARGE PROJECTS**

ADDITIONAL PROJECT PURPOSES: The draft legislation adds authorized purposes for the project, including municipal, industrial, and domestic uses. It also goes far beyond authorizing fish and wildlife as a project purpose, setting a goal of recovering and maintaining self-sustaining harvestable populations of native fish, both anadromous and resident species, throughout their historic distribution range in the Yakima Basin.

EXPANSION OF CONSERVATION AND HABITAT PROJECTS IN TRIBUTARIES: Many of the most compelling habitat restoration projects require water conservation in tributaries, where existing federal law does not authorize Yakima Project investment. The water conservation programs are extended upstream to the tributaries.

REPAYMENT TERMS FOR IRRIGATION WATER USERS: Longstanding criticism of Reclamation water projects focused on highly subsidized repayment terms (40-60 year repayment at zero interest with costs shifted to hydropower when even that financing subsidy exceeded irrigators’ “ability to pay”). For the Initial Development Phase, water users agreed to an interest rate at the federal cost of long-term funds, reasonable repayment terms, and no use of “ability to pay” cost-shifting provisions.

WSU REPORT AND DISAGGREGATED BENEFIT-COST ANALYSIS OF YBIP

Yakima Basin Plan

Benefit-Cost Analysis

Fisheries Benefits

Fish Recovery Elements

Marketing Potential

Infrastructure Considerations

As further discussed in the following article, the State of Washington Capital Budget for 2013 tasked the State of Washington Water Research Center (WRC) to prepare a disaggregated benefit-cost analysis of the individual elements of YBIP. It is beyond the scope of this article, and beyond the expertise of these authors, to fully address the results of the WRC study. However there are significant issues raised by the WRC study that we will address.

ON SEVERAL POINTS WE ARE IN AGREEMENT WITH THE WRC STUDY

FISHERY RECOVERY: Fishery recovery, and specifically fish passage at the reservoirs, was found to meet a benefit-cost (B-C) test. We could not agree more that this is worth doing, but not strictly from an economic perspective, and recovery efforts should not be limited to fish passage.

As conservationists, we usually try to preserve what is left of nature. In this case, we strongly believe that YBIP can restore what has been lost. Bringing large numbers of salmon back into the Yakima will have benefits far beyond an academic and abstract economic concept. With the return of salmon, bears, wolves, eagles, and other carnivores have a better chance in the basin. Nutrients brought back into the system from the ocean will support healthier forests. Recreation — from fall fish watching that has already started above Lake Cle Elum to expanded fishing opportunities — is taking hold. Further, while we do not speak for the Yakama Nation, we respect that they have Treaty Rights to hunt and fish and suggest that those rights imply a promise not to destroy that hunting and fishing in their usual and accustomed places, including the Yakima River and its tributaries, as Reclamation dams and water projects have done.

While we agree that fish passage is critically important, we would go further and propose that the other fishery elements — habitat restoration and flow improvements — are equally worth doing despite the WRC’s conclusion that they are unlikely to pass a B-C test. First, WRC’s fishery analysis appears to conclude that fish are likely to return much more slowly than either previous analysis by other fisheries biologists or than the experience of sockeye recovery in the Okanogan River system. Salmon survive by being opportunistic — when new habitat is opened (especially through a combination of passage, habitat restoration, and flow) they rebound quickly. The Yakama Nation’s program to introduce wild Wenatchee and Okanogan sockeye into Lake Cle Elum will further speed the pace of fisheries restoration, and the early success of this program backs that up (as noted above, replacement values of naturally spawned sockeye are already slightly above 1-1 with a fish passage system that is vastly inferior to the one that will be constructed through YBIP). The WRC study assumed very slow rates of population growth, which strongly skews economic analysis using a time-value of money approach. Second, flow and habitat work is likely to support the fishery restored through passage. For instance, the benefits to ESA-listed steelhead from opening up Manastash Creek habitat currently restricted by low flows and an impassable diversion dam, and restoring habitat in the Teanaway, will be at least as meaningful as passage at the Reclamation dams (which will benefit steelhead, chinook, coho, and bull trout as well as sockeye).

WATER MARKETING: The overarching conclusion in the WRC study is that water marketing — which moves water from lower economically valued uses to higher valued uses — is more beneficial than many of the investments proposed in YBIP. Again, we could not agree more that water markets could solve many of the problems in the Yakima basin. With a fresh adjudication of surface water rights, and restriction of new groundwater appropriations, it is time to identify unnecessary impediments to efficient transfer of water within the basin and streamline the market. The WRC study explicitly and implicitly identifies impediments and opportunities to improve water marketing that should be incorporated into YBIP. This is something we pushed to have a higher profile in YBIP and want to see developed.

However, the WRC study assumed few significant constraints to water marketing. Experience in the basin and anecdotes suggest that constraints to trading are real, and will take significant work to overcome. Further, trading with agricultural sellers may not address fully the needs of year-round water demands from the municipal, industrial, and domestic sectors, and instream flow needs. We are less convinced that water marketing eliminates the need for any additional storage in the basin, especially in light of climate change and associated snowpack reductions.

THERE ARE ALSO AREAS WHERE WE BELIEVE THE WRC STUDY FELL SHORT. SOME OF THESE INCLUDE:

INFRASTRUCTURE PROJECTS: The big infrastructure projects were found not to meet a B-C test by the WRC; some, like the KDRPP project, could plausibly pass under some scenarios, the others fail.

To some extent, this results from different data. The WRC relied on a longer data set that included less frequent and less severe droughts, because drought has occurred more often in recent years, and used a different standard for drought. Which data set and drought standard is more appropriate is a matter of judgment — hydrologists always prefer longer data sets, while if climate has already changed drought frequency, more recent data may be a better predictor of the future. The snowpack in the Cascades is awfully thin this year, and an atmospheric scientist at the University of Washington has noted that this

Yakima Basin Plan

Irrigators' Contributions

Flow Management

Deferred Projects

Conservation & Targeted Use

Unquantified Benefits

year may be a preview of typical conditions by 2070 (*see* <http://cliffmass.blogspot.com/2015/02/the-winter-of-2070.html>). This less severe data set skews the results for projects that are intended to address increasingly frequent severe water shortages.

In addition, given the lack of progress on controlling climate change emissions around the globe, the moderate climate change scenarios used by the WRC as the scenario most likely to occur seems increasingly optimistic. More pessimistic climate change scenarios increased B-C ratios and made KDRPP (barely) cost effective even on a stand-alone basis. KDRPP is the only major water supply project proposed for the YBIP's initial development phase.

When Dr. Jonathan Yoder, the report's lead author (and author of the article following ours in this issue of *The Water Report*), presented the study to YBIP stakeholders, he was asked if the irrigation districts were willing to pay the full cost of a project, would that cause him to reassess his economic analysis? His answer was yes. The irrigation districts involved are proposing to pay essentially full cost for KDRPP — minus only the small subsidy involved in using federal cost of funds rather than borrowing on the municipal bond market. This suggests that the irrigation districts place a high value on the insurance policy KDRPP represents, especially for high value and high investment crops such as orchards and vineyards. Should they have the opportunity to, and choose to, go forward with the project, their economic analysis will be backed by real financial commitment.

The K2K conveyance project has evolved into primarily a flow management project for the fishery rather than a water supply project. While the WRC study places a very low value on infrastructure for flow augmentation, it is unclear how it would value infrastructure like K2K, which seeks to reduce high irrigation conveyance flows to more natural flows better for salmon and steelhead rearing and spawning in what will, with K2K, become a highly productive reach of river for salmon spawning and rearing.

The other large, expensive, controversial projects — i.e., Wymer Reservoir and Bumping Reservoir expansion — are deferred for subsequent phases of YBIP. By then, the effects of climate change and increased water marketing may provide a better basis for evaluating the benefit of the projects. Economic analysis, like weather forecasting, is pretty good in the short term. Performing economic analysis of a water plan over 30 or 40 years means making assumptions of drought frequency, agricultural markets, technological change, population trends and other factors that are really hard to predict. Some guesses are likely to be right, others will be wrong. Appropriately, the draft federal YBIP legislation includes a provision calling for updating water demand and supply analysis before proceeding to authorize a subsequent phase of YBIP.

WATER CONSERVATION: The WRC study found water conservation literally valueless, because it does not create “new water” — the water in this fully appropriated basin is already claimed, including conserved water. While the point the study makes is accurate — conserved water is used by somebody — they miss the systems level approach that tighter systems (those with less uncontrolled loss), are more manageable. The conserved water can be used with intent, for fish or farms, rather than haphazardly. If this benefit is not captured by an economic analysis, the analysis is lacking, not the conservation.

UNQUANTIFIED BENEFITS: It is hard to fault the WRC study for avenues of investigation it did not take while under significant time constraints. The Ecology and Reclamation study found adequate benefits to justify the project in the salmon fishery restoration, irrigation economy, and municipal and industrial uses, and stopped. They too did not look farther.

AMONG THE UNQUANTIFIED BENEFITS MISSED BY BOTH STUDIES ARE:

- **POTENTIAL FOR DELISTING MID-COLUMBIA STEELHEAD FROM ESA PROTECTION:** Mid-Columbia River steelhead are close to being restored to population levels and distribution that warrant delisting. When a strong population is restored in the Teanaway River and other key tributaries, which is a near-term YBIP goal, ESA protection could be lifted. While the economic value of that is hard to quantify, it surely cannot be low. When species are listed, the outcry is almost always that listing species has negative economic consequences due to legal uncertainty and reduced flexibility for resource managers. When species are de-listed it must have positive economic effects.
- **BULL TROUT:** YBIP is also designed to support ESA-listed bull trout populations through fish passage that would allow migration and gene transfer in the system and additional nutrients as well as habitat restoration.
- **RECREATION:** A strong salmon fishery in the Yakima would have both direct and indirect value. Fishing is expensive and draws anglers from long distances. The Yakima River Canyon's already famous trout fishery, as well as tributary trout fisheries, would certainly benefit from the added nutrients brought into the system from the ocean. Fish watching as well as watching other animals and birds fed by the fish is likely to have benefit, just as eagle viewing at Washington's Skagit River does. Already tourists are beginning to gather in the fall on the Cooper River bridge to watch spawning sockeye reintroduced by the Yakama Nation. That same sockeye fishery, less than 100 miles from Seattle, will eventually generate significant revenue for local communities when it opens for fishing, just as sockeye seasons do on Lake Washington (where they are increasingly rare) and Lake Wenatchee.

Yakima Basin Plan

Unquantified Benefits (Continued)

Elements in Isolation

Interrelated Challenges

- **ECOSYSTEM SERVICES:** We encouraged both WRC and the Reclamation-Ecology study to look at the ecosystem services benefits of headwaters protection, floodplain restoration, and other restoration actions in terms of the benefits to clean water, water supply (in- and out-of-stream), and flood safety. Ecosystem services analysis is legitimate enough to have been included in the new White House Principles and Guidelines to guide federal water investments, and the failure of any entity to date to analyze the ecosystem services provided and protected by the YBIP is unfortunate and a problem waiting to be addressed.
- **TREATY RIGHTS:** Also difficult to quantify is fulfillment of the Yakama Nation's 1855 Treaty rights that include hunting and fishing. Without fish in the rivers, those rights are meaningless.
- **GETTING THINGS DONE:** Before the YBIP, progress on land acquisition, water conservation, habitat restoration, and especially fish passage, was moving slowly, if at all. The cooperation between stakeholders directly brought about through the YBIP has unleashed rapid progress on all these fronts. The Teanaway is now protected, which would not have happened without the YBIP. Manastash Creek is a perennial stream for the first time in 100 years thanks to outright enthusiasm for water conservation and stream restoration by local irrigators. Reclamation is about to break ground on Cle Elum fish passage. And drought relief is on its way for farmers from KDRPP. The benefits of collaboration are sometimes dismissed as "intangible," but the results this collaboration is achieving are visible and real. The working relationships formed will have added benefit when hard decisions have to be made during drought years like 2015 is shaping up to be.

CONCLUSION

The WRC study looks at each element in isolation as was its charge from the legislature. It is no surprise that when examined in isolation the analysis finds parts of the YBIP worth doing and others not worth the price. Looking at projects in isolation, most any stakeholder might come to a similar conclusion whether based on economics or personal values. The project was developed to address many needs along the Yakima River, not just economic needs, and looks ahead to climate changed conditions never before experienced. Supporters of the YBIP are working to find political and technical solutions to a huge set of problems — decimated salmon, ESA-listed steelhead and bull trout, drought, climate change, flood management, and maintaining a strong agricultural and recreational economy. After years of litigation and progress toward solving the basin's problems only in fits and starts, the YBIP provides a solution with a fighting chance of outpacing challenges like climate change and population growth. A study that disaggregates YBIP actions can help refine future choices, but the only way to meet fishery and water supply challenges in a complex watershed like the Yakima Basin is through the approach the YBIP embraces and models.

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YAKIMA BASIN INTEGRATED PLAN BENEFIT-COST ANALYSIS

AN APPEAL FOR EVIDENCE-BASED DISCOURSE ABOUT THE

STATE OF WASHINGTON WATER RESEARCH CENTER STUDY OF THE YAKIMA BASIN INTEGRATED PLAN

by Jonathan Yoder

Professor, School of Economic Sciences, Washington State University (Pullman, Washington)
 Director, State of Washington Water Research Center (Pullman, Washington)

Acknowledgements: *I thank several of the co-authors of the Benefit-Cost Analysis of the Yakima Basin Integrated Plan Projects (<http://swwrc.wsu.edu/2014ybip/>) for helpful comments. However, I am solely responsible for the content of this article.*

INTRODUCTION

The Washington State Legislature charged the State of Washington Water Research Center (WRC) to carry out a benefit-cost (B-C) analysis of the Yakima Basin Integrated Plan (YBIP) projects, which it delivered in December of 2014 (hereafter the WRC report, available at <http://swwrc.wsu.edu/2014ybip/>).

The WRC research team was fortunate to be able to build upon prior work in the form of an earlier B-C analysis, called the Four Accounts (FA) analysis (ECONorthwest et al., 2012), and an extensive set of supporting studies of the YBIP and its component proposed projects. The FA analysis was commissioned by the US Bureau of Reclamation (Reclamation) and the State of Washington’s Department of Ecology Office of Columbia River (OCR), both of whom are active in the design and planning of the YBIP. The FA analysis reports that the YBIP as a whole passes a B-C test (such that benefits outweigh costs).

The FA analysis is a B-C analysis limited to a comparison of the full YBIP against a “No YBIP” alternative. In contrast, the WRC was charged to perform B-C analysis of individual projects within the YBIP. The WRC study therefore required a new careful analysis of the contribution of individual projects to the YBIP. In addition, as always in research endeavors, the WRC research team took the opportunity to update and improve on methods used in the earlier studies wherever possible.

Because of the methodological improvements and the difference in objectives, the results of the two studies differ in several ways. Based on the new WRC analysis, none of the water storage projects pass a B-C as part the YBIP, but fish passage projects do. Further, the WRC study finds that the YBIP as a whole does not pass a B-C test.

As academic researchers working on behalf of the WRC mission and respective university values of independent, science-based research, we do not have the luxury of deciding ahead of time what the results of a research study will, or should be. Results must follow from defensible methodological foundations. The WRC study includes no policy prescriptions whatsoever, and the results should not be construed to indicate a policy position held by any of the WRC study authors.

Nonetheless, it is clear and unsurprising that the WRC results have been interpreted as less supportive of the YBIP than the previous B-C work commissioned by the YBIP proposal developers. YBIP proponents have leveled several criticisms at the WRC study since its publication. Many have originated from the YBIP Implementation Committee (IPIC), and several of these are included in Malloch and Garrity’s article in *The Water Report* (this issue, hereafter referred to as MG). Garrity is a member of the IPIC, and Malloch is affiliated with the larger YBIP Workgroup.

The objective of this present article is to respond to the most salient published criticisms. It is not possible due to space limitations nor would it be effective to try to respond to all criticisms that have been forwarded by YBIP proponents. Nonetheless, this article provides evidence and explanation to show that many of the claims to date against the WRC study are unsupported or unsupportable, misleading, or falsifiable upon examination of the WRC report. My intent is not to discredit YBIP supporters or the YBIP itself, but to dispel unsupportable criticisms of WRC study, and to respond constructively to legitimate ones. My hope moving forward is to invite and participate in an evidence-based debate about the complex issues surrounding the YBIP.

The WRC study is not perfect; no study of an economic and environmental system as complex as the Yakima Basin could be. It necessarily relies on assumptions and methods deserving of debate and broad consideration of evidence. Nonetheless, my appraisal is that criticisms to date do not provide clear implications or convincing evidence to substantively alter the WRC assessment. However, recently published increases in two YBIP water storage project cost estimates are more consequential for initial YBIP development proposals.

Yakima
 Basin Plan
 Benefits/Costs

Legislature’s
 Direction

Previous
 Analysis

Science-Based
 Research

Criticisms

Seeking
 Evidence-Based
 Debate

<p>Yakima Basin Plan Benefits/Costs</p> <p>Fish Run Growth</p> <p>Marketing Restraints</p> <p>Data Set Range</p> <p>Irrigation Payments</p> <p>Conservation Worth</p> <p>Disaggregated Analysis</p> <p>Fish Recovery Rates</p>	<p style="text-align: center;">RESPONSE TO CRITICISMS</p> <p>A synopsis of some of the criticisms and my responses are provided first. Supporting evidence provided thereafter is organized to coincide with the flow of MG’s commentary on the WRC report.</p> <p>SALIENT CRITICISMS</p> <p>Claim: <i>“The WRC study assumed very slow rates of [fish] population growth, which strongly skews economic analysis using a time-value of money approach.”</i></p> <p>Response: To the contrary, the WRC study provides a wide range of results including the high rates of growth implicitly assumed in the FA analysis. We justify lower growth rates within this range based on peer-reviewed analysis and the definition of the YBIP itself.</p> <p>Claim: <i>“...the WRC study assumed few significant constraints to water marketing.”</i></p> <p>Response: This is untrue. The WRC study provides results for a full spectrum of market outcomes, from completely ineffectual markets to fully efficient markets. Although we provide extensive discussion of water market frictions and constraints and their likely impacts, we justify an emphasis on intermediate market outcomes less restrictive than those assumed in the FA analysis.</p> <p>Claim: <i>“The WRC relied on a longer data set [than the FA analysis] that included less frequent and less severe droughts, because drought has occurred more often in recent years, and used a different standard for drought.”</i></p> <p>Response: This is true, but the implication that the WRC study simply assumes a less adverse climate is false. We provide results based on a broad range of climate scenarios, from a historical climate regime to climate regimes substantially more adverse than that assumed in the FA analysis.</p> <p>Claim: <i>“If irrigation districts propose to pay the cost of storage projects, the WRC results must be suspect.”</i></p> <p>Response: This claim misconstrues a misquoted statement I made to suggest that I concede doubt in our results. My intent was not to convey doubt in our results, but to convey doubt in the claim that irrigation districts will pay the full costs of YBIP water storage projects.</p> <p>Claim: <i>“The WRC study found water conservation literally valueless, because it does not create ‘new water’ — the water in this fully appropriated basin is already claimed, including conserved water.”</i></p> <p>Response: This is easily falsifiable by reading the WRC report. Further, the WRC clearly and openly delineates data limitations that limit our ability for a full accounting of conservation benefits. Ancillary claims in MG (discussed below) misconstrue the nature of the limitations of our study with respect to conservation benefits.</p> <p>Claim: <i>“A disaggregated analysis divides the plan into individual components and evaluates the efficacy of those components in isolation,” and it is inappropriate to perform B-C analysis in the component parts of the YBIP.”</i> (Garrity et al. 2015).</p> <p>Response: This claim is logically unsupportable. The WRC study goes to great length to account for the interrelationships among projects in order to assess individual components in a logically defensible way.</p> <p>CATAGORIZED CRITICISMS: SUPPORTING EVIDENCE & DISCUSSION</p> <p>The section headings below correspond to those in MG.</p> <p>FISH RECOVERY</p> <p>Claim: <i>“The WRC study assumed very slow rates of [fish] population growth, which strongly skews economic analysis using a time-value of money approach.”</i></p> <p>Response: Please refer to the WRC report discussion beginning on page 93. The salmonid population growth rates relied on in the WRC study (5 percent, and for comparison 10 percent) are based on the most comprehensive meta-analysis published in a peer-reviewed journal article to date (McClure et al. 2003). A 5 percent growth rate is higher than 85 percent of the population growth rates estimated for Columbia River Salmonids. The FA analysis did not report population growth rates, however, the lower and upper bound estimates for sockeye abundance in the timeline demand 20 to 40 percent growths rates, the latter of which is higher than any reported in McClure et al. (2003). Although instantaneous or single-year rates may approach and even exceed these higher values in special circumstances, such as at the initiation of a recolonization (e.g. Pess et al. 2014), expecting population growth rates to be sustained at 40 per cent for the duration of the YBIP planning period is inconsistent with current understanding of salmon population biology (Milner et al. 2003), and therefore unreasonable. Thus, relative to the existing peer-reviewed literature, the growth rates we assume are not “very slow” as MG claim, but are more reasonably described as optimistic. Given the way in which we rely on peer-reviewed literature on population growth rates, we dispute MG’s claim that we assume return rates much lower than previous analyses by other fisheries biologists.</p>
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**Yakima
Basin Plan
Benefits/Costs**

**Hatchery
Considerations**

**Water
Marketing
Spectrum**

That said, the growth estimates used in the WRC analysis based on McClure et al. (2003) do not account for additional importation and/or hatchery investments in the Yakima Basin beyond that which has supported the existing populations, which act as the baseline for our growth estimates. Future importation and/or hatchery investments would support higher abundance growth rates (*see* WRC analysis Appendix discussion starting on p. 162, and specifically pp. 164-166). We did not include further hatchery and introduced fish in our calculations because these planned future restoration activities are not part of the YRBWEP’s definition of the YBIP, and our legislative charge was to consider YBIP projects. If the YBIP is to be credited for fish abundance increases supported by hatchery and importation (thereby making the comparison to sockeye growth in the Okanogan as cited by MG more legitimate), then the costs of these programs should be included in the B-C analysis. The FA analysis relied on these high growth rates but did not account for the cost of activities to support them, which skews the B-C estimates for fish benefits upward.

WATER MARKETING

Claim: “...the WRC study assumed few significant constraints to water marketing.”

Response: This statement is incorrect. The WRC study reports results representing a full spectrum of water market outcomes, described in substantial detail (e.g. p. 38-41, and p. 144-148). We also spend three pages (p. 41-44) describing market frictions that can lead to attenuated market outcomes. The market outcomes we consider range from what we call “no trade” (or “proportional curtailment”) to full trade (with and without transaction costs). “No trade” in our working definition is extremely restrictive. It mean that no markets function at all, and that irrigators ignore differences in economic returns to water across crops and curtail water to all crop types regardless of return (see p. 38-39). The no trade and full trade scenarios are unrealistic “bookends” that we use to define the full range of possible outcomes. In addition, we subtract liberal estimates of transaction costs based on existing literature from the estimated gains from trade. Although we provide results for this full range of market regimes, we justify and focus on intermediate market outcomes, which we show are remarkably similar to estimates in the FA analysis, all else being equal.

**ESTIMATED COSTS FOR YAKIMA INTEGRATED PLAN DEVELOPMENT
30 YEAR IMPLEMENTATION PERIOD**

INTEGRATED PLAN ELEMENT	INITIAL DEVELOPMENT PHASE (Decade 1)	INTERMEDIATE DEVELOPMENT PHASE (Decade 2)	FINAL DEVELOPMENT PHASE (Decade 3)	FULL DEVELOPMENT COSTS (3 Decades)
Habitat/Watershed Protection and Enhancement	\$201,700,000	\$139,400,000	\$139,400,000	\$480,500,000
Fish Passage (6 projects)	\$186,400,000	\$133,600,000	\$108,400,000	\$428,400,000
Surface Water Storage	\$413,900,000	\$1,003,600,000	\$999,000,000	\$2,416,500,000
Groundwater Storage - Regional and Municipal	\$6,400,000	\$58,400,000	\$58,400,000	\$123,200,000
Structural and Operational Changes	\$150,000	\$63,500,000	\$63,500,000	\$127,150,000
Enhanced Water Conservation	\$87,500,000	\$171,000,000	\$171,000,000	\$429,500,000
Market Driven Reallocation	\$850,000	\$1,050,000	\$1,050,000	\$2,950,000
Integrated Plan Update Costs		\$1,500,000	\$1,500,000	\$3,000,000
TOTAL	\$896,900,000	\$1,572,050,000	\$1,542,250,000	\$4,011,200,000

Adapted from: Yakima River Basin Integrated Water Resource Management Plan Cost Estimate and Financing Plan
WA Dept of Ecology Legislative Report, December 2014
See: www.ecy.wa.gov/programs/wr/cwp/images/pdf/YBIP_LEG_REPORT_2014.pdf

**Yakima
Basin Plan
Benefits/Costs**

**Market
Effectiveness
Questioned**

**Market
Development**

**“Need”
&
Pricing**

**Water Storage
Cost Impacts**

**Drought
Frequency
Considerations**

**Adverse
Climate Change**

It is also noteworthy that FA analysis assumptions are empirically very nearly equivalent to our “no trade” scenario (bottom of p. 70, top of page 71). This assumption leads to the highest possible range of YBIP benefit estimates. Thus, while the WRC study does not “assume few constraints” as MG claim, the FA analysis in contrast is based on untenable implicit and very restrictive assumptions about markets and on-farm economic decisions, that assume uneconomic behavior on the part of irrigators and happen to maximize the estimated potential benefits of YBIP infrastructure projects relative to all other possible market assumptions.

The Yakima River Basin Integrated Plan Implementation Committee (2014) makes a corollary to the above claim by stating in various ways that the WRC study overestimates the extent to which markets can alleviate water scarcity issues in the basin:

“Actual experience during the 2005 drought, when most barriers to transfer of water were greatly reduced or eliminated, demonstrated that quantities of water generated from marketing approaches paled in comparison to actual water needs.”

This claim requires a two-part response. First, the 2005 experience represents the market status quo ten years ago. A good deal of water market development has happened since then. The implication that water markets can’t be more effective than they were in 2005 is therefore questionable at best. History is rife with examples of market development in the face of increasing potential gains from trade. You need only look to the Upper Kittitas water market for exempt well mitigation that has developed since then as an example (Cronin and Fowler 2012).

Now I will pick on the word “need” as used by both MG and the Yakima Basin Integrated Plan Implementation Committee. If buyers had offered more than they did (reportedly around \$158 per acre-foot), they likely would have been able to purchase more water. But their offer suggests that they did not need the water enough to pay a higher price. This is not to denigrate the economic hardship that a drought can create; these economic hardships are real. The point is that satisfying a “need” always comes at a cost. One can purchase summer water by purchasing more storage at the cost of infrastructure. Or one can purchase water based on existing water infrastructure at the opportunity cost of that water for competing uses. The question is, which approach (or combination of approaches) provides the highest net benefits?

Further, to imply that water markets would not move as much water around as would be provided by the YBIP water storage projects hints at the fact that the benefits of more water storage are overshadowed by the costs of more water storage. Thus, MG’s statement “We are less convinced that water marketing eliminates the need for any additional storage in the basin...” is not a meaningful statement in the real world of tradeoffs. Of course markets will not eliminate wants for more water storage, but they can alleviate the economic impact of drought. Another statement made by an IPIC member in testimony to the Washington State Senate Ways and Means Committee is that the “bulk of the water that was identified in that study [for market transfer] is absolutely not transferable” — (beginning at minute 45:10 Sandison et al. 2015). There are many facets of this broad statement (and preceding statements in this testimony) that I could address constructively, but I will note only that no evidence whatsoever was given to support this claim.

INFRASTRUCTURE PROJECTS

Claim: “The WRC relied on a longer data set that included less frequent and less severe droughts, because drought has occurred more often in recent years, and used a different standard for drought.”

Response: We did indeed use a longer dataset than the FA analysis, and it does make a big difference in the value of YBIP storage projects. However, a quick look at the WRC analysis Figure 14 illustrates the first reason why this statement is misleading at best: we use the data from 1925 onward, and there is a series of droughts and concomitant curtailments between 1925 and 1945 that is as adverse as the recent years since 1970. To the extent that the hydrological cycle is stationary, this series should indeed provide more information than the data relied on in the FA analysis, and it should therefore be used.

Despite the implication of MG, use of the longer dataset does not imply that we ignored the potential for (non-stationary) adverse climate change. To the contrary: we ran four climate scenarios ranging from historical to adverse. We chose to emphasize one particular climate scenario (CMIP3 CGCM 3.1, which is more adverse than historic in terms of curtailments) precisely because the average annual curtailment rates matched the FA curtailments most closely (but slightly more adverse) under baseline (no YBIP) conditions.

Now consider the climatological assumptions used in the FA analysis: one-year droughts happen every five years, and three-year droughts happen every 20 years. Without the YBIP, proratable rights are assumed to be prorated to 30 per cent of entitlements in each drought year. Figure 14 of the WRC analysis includes simulated average curtailments that are very similar to actual curtailments, and shows that curtailment reached 70 per cent (30 per cent proration) just once in recent years. FA then does a sensitivity analysis assuming proration rates of 20 per cent and 40 per cent.

Yakima Basin Plan Benefits/Costs
Curtailment

The more important difference between the WRC and FA analyses is that the FA assumes that the full YBIP would guarantee a minimum of 70 per cent proration, so that for every drought year, the YBIP is assumed to reduce curtailment from 70 per cent to 30 per cent (again, with sensitivity analysis based on 20 per cent and 40 per cent proration during drought years). The empirical/theoretical basis of this assumption of the impact of the YBIP on curtailment is weak to nonexistent (*see* the FA analysis section 2.2.2.1 and onward for details), yet this is a big difference in curtailment. So big, in fact, that the reduction in average curtailment due to the YBIP in the FA analysis is eight-times the difference in average curtailment shown in the WRC study to results from YBIP implementation based on YAKRW hydrological simulations (*see* p. 66-68 in the WRC analysis).

Editor's Note: YAKIMA BASIN'S PRORATABLE WATER RIGHTS

A 1945 Consent Decree created an unusual water rights structure in the Yakima River Basin (the decree was issued in *Kittitas Reclamation District v. Sunnyside Valley Irrigation District*, Civil Action No. 21 (Eastern District of Washington, Southern Division, Jan. 1945)). Pursuant to the 1945 Consent Decree, Reclamation annually determines the Total Water Supply Available (TWSA). Pre-1905 rights amounting to about half of the Basin's surface water rights receive their full water supply before junior right holders receive any. Next up are users whose rights date to the 1905 Reclamation appropriation. These rights are termed "proratable" and are cut back equally in any shortage. Post-1905 rights receive no water if the proratable rights are shorted and there is a "call" for water (i.e., a senior water right owner requests regulation of junior users so that the senior user receives the full amount of their right). The most senior rights holders thus had little concern about their water supplies because they historically have never been shorted. However, the largest and most economically productive water districts rely in large part on proratable rights. Prior to the regionally historic 1977 drought, proration was of only modest concern for the Reclamation irrigators — there had not yet been a serious shortage of water that resulted in significant proration. Since the Seventies, however, there have been several years where proratable rights holders received less than 70% of their water, the threshold irrigators see as causing very serious economic pain. Adapted from Garrity and Malloch, *TWR* #106.

Climate Inputs

Irrigators' Payments

Federal Funding Requirements

State Funding

After implying that we chose to emphasize less adverse climate results, MG cite the Cliff Mass Weather Blog (<http://cliffmass.blogspot.com/2015/02/the-winter-of-2070.html>). Interestingly, a careful comparison of the contents of this blog (based on the first map and graph and accompanying text) and the climate regime summary statistics reported in WRC study Table 3 (p. 28) shows that the HADGEM climate regime for which we report results is substantially more adverse in terms of both temperature and precipitation change than that favored in the Cliff Mass Weather Blog. Like the IPCC, we make no claims as to which scenario to rely on beyond the more frequent use of CGCM 1 for comparison to the FA analysis. Thus, we do not assume a benign climate — we report a range of results for a range of climates for readers to assess for themselves.

To be fair, the FA analysis did not have access to the modeling data used in the WRC analysis, and we do not fault them for that. One of the consulting firms who contributed to the FA analysis and subsequently helped develop the YAKRW modeling framework is now using YAKRW for further analysis commissioned by Reclamation. It is somewhat surprising that MG suggest continued reliance on old modeling assumptions when the authors themselves have moved on to more scientifically defensible data methods.

Claim: *"The irrigation districts involved are proposing to pay essentially full cost for KDRPP — minus only the small subsidy involved in using federal cost of funds rather than borrowing on the municipal bond market."*

Response: In testimony at the Washington State House Ways and Means Committee work session (Sandison et al. 2015, starting at about minute 44.20), another IPIC committee member stated that irrigators have included in draft legislation at the Federal level that they will pay their share of the construction, operation, maintenance costs, and interest, of the Kachess Drought Relief Pumping Plant (KDRPP) proportional to their share of the irrigation benefits, and that the WRC study failed to account for this fact. I will make several points about these claims.

First, no matter how the project costs are divided up among irrigation beneficiaries, these "fair shares" would still sum up to more than the benefits except under the most adverse climate and restrictive market conditions (WRC study, Table 29, page 107). Although *see* below: the higher KDRPP cost estimates always outweigh the out-of-stream benefits. Because federal water infrastructure investments have been required to satisfy a B-C test such that the benefits are larger than costs, the relevance of this draft legislation is questionable (Hahn and Sunstein 2002; US Water Resources Council 1983; Council on Environmental Quality 2014), because the project would not be eligible for federal funds. Needless to say, signed and binding service contracts with Reclamation would be more convincing.

Second, to the extent that funding is provided by the State of Washington and not the Federal government, it is likely to be funded at least in part under RCW 90.90, which does not require full or even partial cost recovery of water supply development (RCW 90.90.100 (6); <http://apps.leg.wa.gov/rcw/default.aspx?cite=90.90.100>). So, I am skeptical about the likelihood of full construction cost recovery without credible evidence of contractual commitment to full cost recovery by the Federal and/or State governments.

Yakima Basin Plan Benefits/Costs

Cost Estimate Developments

Irrigators' Cost Share Implications

Conservation Valuation

Third, construction, operation, maintenance costs, and interest, are not the full cost of these projects. For example, as noted in the WRC analysis (p. 107), the Draft Environmental Impact Statement (DEIS) for the Kachess Drought Relief Pumping Plant and the Keechelus Reservoir-to-Kachess Reservoir Conveyance (KKC) recognizes that property values around Kachess may be harmed (Reclamation 2015). A full accounting of costs would include these costs potentially imposed on Kachess property owners. I doubt these costs are being considered by the irrigation districts, but they should be if they are going to make claims of full cost repayment.

Fourth, the estimated costs in the KDRPP and KKC have been updated in the KDRPP/KKC DEIS, which was published very shortly before the WRC report was due. The WRC analysis relies on earlier engineering cost estimates for the proposed YBIP projects, but the new cost estimates are higher, and this has important implications for the B-C analysis. A B-C test is satisfied if the B/C ratio (benefits divided by costs) is 1 or larger, such that benefits are at least as large as the costs. The WRC analysis finds that KDRPP provides a B/C ratio of 1.27 (Table 29, p. 107) based on out-of-stream uses under the most restrictive market and climate conditions, if implemented alone without other YBIP water storage projects, and assuming the old KDRPP cost estimate of \$196 million. Under those same conditions, KDRPP combined with KKC provides a B/C ratio of 1.53 at an estimated cost of \$334 million. The new KDRPP cost estimates reported in the DEIS (alternatives 2A and 2B) are \$434.4 million and \$380.7 million, respectively — which are about double that of the earlier KDRPP estimates. Given these costs, the maximum B/C ratio provided for KDRPP alone is 0.65, which means KDRPP alone never satisfies a B-C test based on out-of-stream uses. KKC costs are also higher, at \$221.3 million to \$254.4 million for alternatives 3A and 3B. The consequence is that KDRPP+KKC now also fails to satisfy a B-C test under any market and climate conditions, with a maximum B-C ratio of 0.84 under the most adverse climate and restrictive market assumptions. It should be noted, as we do in the WRC report, that these B-C ratios do not include potential instream flow benefits, but the analysis and caveats that we provide about instream flow benefits in the WRC report still holds (e.g. p. 100-103). However, they also do not include the potential property value diminution that may be incurred due to these projects.

Finally, as noted by MG, I was asked at a Yakima River Basin Watershed Enhancement Workgroup meeting (the workgroup tasked with developing the YBIP, which includes the IPIC) if I would reassess the WRC results if irrigation districts paid the full cost of their projects. The Workgroup meeting minutes state that I said if the irrigation districts fully cover the costs of the water supply projects, this would indeed demonstrate that the benefits estimated in the WSU study indeed are too low (Reclamation 2014b). I am virtually certain this paraphrases and misconstrues what I said (note that there are no quotation marks in the meeting minutes), but my misrepresented response has now apparently become a talking point for YBIP proponents as a foundation to attempt to dismiss the WRC study.

Whatever my exact language, my response was an attempt to be forthright but diplomatic. As an applied, empirically-minded professional economist, intellectual honesty requires me to admit that if a person or group puts their money where their mouth is and actually pays the full cost for something, this is strong evidence that the benefits may outweigh the costs. However, my language was intended to convey doubt about the irrigation districts' claims about repayment rather than to indicate doubt in our results.

It remains true that if the irrigation districts really pays the full economic costs of these water infrastructure costs or even the share of the full economic costs equal to their share of the benefits, it would give me pause in light of my general professional experience as an economist that leads me to take actual investment seriously as an indicator of value. But this outcome seemed then to be unlikely, and even more so now. Even if irrigation districts did pay the full costs, assenting to reassessment does not imply fault in our report beyond what we already state as limitations of our study.

WATER CONSERVATION

Claim: *“The WRC study found water conservation literally valueless, because it does not create ‘new water’ – the water in this fully appropriated basin is already claimed, including conserved water.”*

Response: This is a misstatement of our findings. We report B/C ratios as high as 0.16 for agricultural conservation based on out-of-stream uses (Table 36 on page 113), which means that we do not, literally, find them valueless. In addition, while we cannot effectively quantify instream flow benefits, we clearly state on page 113 that our reported benefits for agricultural conservation are underestimates in this regard.

Secondly, nowhere do we, nor would an economist, state that water conservation or any other movement of water within a system is “valueless, because it does not create ‘new water’.” Markets themselves move water from one use to another without “creating new water” and provide gains from trade, as we show extensively on the WRC analysis. Put another way, water reallocation by conservation practices or by water markets is not a “zero sum game” as has been suggested (Yakima River Basin Integrated Plan Implementation Committee 2014).

Yakima Basin Plan Benefits/Costs

Endangered Species Act Delisting Effects

Recreation Benefits

Flood Risk Costs

Treaty Considerations

Assessing Collaboration's Product

Thirdly, the other factor that we do not quantify is that the type of water reallocation that may result from the agricultural conservation activities proposed under the YBIP may impose costs on others. Indeed, the Kennewick Irrigation District submitted a comment to the WRC stating concern that the YBIP conservation activities may negatively affect the return flows that they rely on for irrigation. Unfortunately, as stated in the WRC, the hydrological model upon which we rely does not capture these potential effects below the Parker Gage, so we are unable to quantify these impacts.

UNQUANTIFIED BENEFITS

Delisting of Listed Salmonids due to YBIP Development

The WRC did not have the time or capacity to consider the net benefits of delisting steelhead and/or bull trout. This would indeed have economic consequences, but I am not so sure the net benefits “cannot be low” — as MG suggest. Delisting may likely reduce landowner habitat maintenance and offset requirements and associated costs. But reducing these requirements would presumably have negative consequences on further potential recovery to the extent that continuing these activities support abundance (unless they are worthless in the first place). These impacts should be accounted for in such an analysis. Further, delisting would reduce or eliminate federal support for restoration actions. There have been 349 habitat restoration projects since 1991, with expenses reported for 71 per cent of those totaling \$63 million, with a rapid increase in annual funding in the post-1999 period (Katz et al. 2007). For the five-year period from 2005-2009 the total expenses on habitat were \$33 million or \$6.6 million/year unadjusted for inflation (NOAA 2013). All of this represents capital inflows into the Yakima basin, which would largely disappear upon delisting. Further, to the extent that there is interspecies competition for resources in the basin, what impact would the reintroduction of so many sockeye to the basin have on steelhead abundance? I do not have answers to any of these questions, but the net result is less obvious to me than it apparently is to MG.

Recreation

MG imply that the WRC study does not account for increased recreation benefits due to the predicted increase in salmon abundances due to the YBIP. In fact, the fish valuation approach used in both the FA analysis and the WRC analysis captures these benefits in principle by estimating both use and non-use values for fish in an integrated way. While there are certainly weaknesses to this approach that we discuss in substantial detail (see Section 3 starting on p. 55 and Appendix Section f), the approach’s breadth of scope — which includes recreation benefits among others — is its primary strength, not one of its weaknesses.

Ecosystem Services

As MG note, there are several aspects of these complex systems that neither the WRC analysis nor the FA analysis capture. In response to MG, a brief note on flood costs and the potential for YBIP flood benefits is worthwhile, with some very back-of-the-envelope calculations using what is probably incomplete data. Based on the Upper Yakima River Comprehensive Flood Hazard Management Plan (Otak, Inc. and KCM inc. 2007), reported flood damage from 1909 to 2003 sums to \$34.75 million, in nominal dollars, or \$369,741/year on average. Deflated by the CPI (base year = 2012), this amounts to an average of \$1.21 million/year in damage. The discounted net present value of an annuity over 100 years (assuming the same flood risk distribution) would be \$29.7 million. Thus, if the same flood regime and damage risk remains into the future, one would expect a net present value of \$29.7 million in losses without the YBIP (there are many caveats to the interpretation of this number). It is unclear how much the YBIP could reduce flood risk below the new dam configurations, in part because this would depend on dam operations in response to flood risk. However, it is likely that the YBIP would reduce only a fraction of this risk (such that flood risk is not zero if the YBIP is implemented). As such, any flood risk reduction benefits would be lower than \$29.7 million (probably substantially so). In relation to the out-of-stream use shortfalls above \$2 billion (WRC analysis, table 19), this is unlikely to make much of a difference.

Treaty Rights

MG claim that we do not quantify the value of the Yakima Nation’s 1855 treaty rights. The fish valuation benefit estimates capture the value of improving fisheries, and so in principle would include the value of fish, and therefore exercise of treaty rights in relation to those fish. Again, however, the valuation methods used, while they are the best available for this specific case (a conclusion also arrived at by the FA analysis authors), do not address these treaty-related values explicitly or independently.

Getting Things Done

The development of a collaboration between groups who were in the past at odds with each other is indeed commendable, productive, and even inspirational to the extent that it has been inclusive and comprehensive (a point of contention in YRBWEP meeting public comments; Reclamation, 2014a). However, from the perspective of a B-C analysis, process leads to results — or at least a proposal — and in this case, the proposal is the YBIP. I do not discount the enthusiasm, satisfaction, and even spillover effects of participants in this process, but from the perspective of the legislative charge of the WRC, effectiveness of the collaboration is defined by the product of its efforts with respect to the YBIP, which the WRC was charged to assess in benefit/cost terms.

Yakima Basin Plan Benefits/Costs

Interdependency Recognition

Conditionality

Conditional Costs

Synergy Accounting

Conditional Analysis

Disaggregation

The YBIP is a set of projects designed to work together to address a number of issues interrelated through water in the basin (Garrity et al. 2015). YBIP proponents have argued that because of this interconnectedness, it is nonsensical and/or misleading to evaluate the individual component parts of the YBIP. Analogues to this claim have been made several times, and I will use some of them as a basis of response.

Claim: “A disaggregated analysis divides the plan into individual components and evaluates the efficacy of those components in isolation. That approach is contrary to the essence of integrated planning, which seeks to capture the synergy of a comprehensive [set, sic] interrelated set of projects and actions that are intended to operate in unison.” (Garrity et al. 2015).

Response: To the contrary, it is indeed logically supportable and possible to estimate the benefits of individual components of a system of projects such as the YBIP, in which the outcomes are interdependent. The key is to recognize that the benefits of any given project are dependent on whether or not other projects are implemented.

Benefits from fish passage projects in the basin are likely to be dependent to some degree on instream flows and habitat quality above and below the fish passage project. The benefits from one water storage project are likely to depend on which of the other storage projects are implemented. Accounting for this conditionality is logically equivalent to accounting for the interconnectedness in the system. Economists frequently apply this sort of analysis when modeling multi-input and multi-output production relationships.

Unfortunately, interdependence of project impacts means that there cannot be just one answer to the question: “what are the benefits of the Wymer Dam and Reservoir?” The value of the Wymer Dam depends on which other water storage projects are also built. The entire WRC analysis is built around accounting for this conditionality, thereby accounting for interconnectedness. For example, the Methods section of the WRC analysis begins with a discussion of how to address this interdependence (WRC analysis, p. 16-17). In the Executive Summary (p. ii-iv), we summarize a set of estimates that represent benefits of water storage projects implemented alone, and another set that represents the benefits when implemented as a part of the full YBIP implementation. These two sets of benefits are different from each other for each respective project precisely because the system is economically and physically integrated.

Thus, accounting for conditionality in our “disaggregated analysis” by definition means that the components are not being considered in isolation from each other in the WRC analysis. Instead, we are accounting for interdependencies that YBIP proponents contend lead to synergies, as the following quote suggests:

“This is clearly a case where the whole is greater than the sum of the parts, but we’re always going to have the challenge to explain that to people.”

(Prengaman 2013, quoting the Director of the Office of Columbia River, State of Washington Department of Ecology).

Interestingly, to make this claim requires the ability to assess both the parts, and the whole — a comparison that the first claim (above) against disaggregation suggests is inappropriate. And more interestingly, while this adage is often used, it is not always true. To illustrate, the WRC analysis estimates the value of water storage projects conditional on whether the other storage projects are implemented. Our results show that if all storage projects are implemented, each provides lower benefits than if any of them were to be implemented alone (*see* for example, Table 12). The last water storage project provides less insurance value per acre-foot of water it provides than does the first. In other words, one might instead say the whole is worth less than the sum of its parts.

Granted, using only the water storage projects to illustrate this point ignores the contribution that instream flows, fish habitat restoration, and fish passage contribute to the YBIP as a whole. So, where do these synergies lie? I illustrated above conceptually (and we discuss in the WRC report) that there may be physical and therefore economic synergies between instream flows, habitat conservation, and fish passage. To the extent that adding storage makes it easier (less costly) to provide instream flows, then there is an indirect synergy between storage and other fish-related investments, through instream flow augmentation. The problem is that: (a) WRC analysis results suggest that any synergies are not sufficient to support positive B/C ratios for the water storage projects; and (b) purchasing rights for instream flows would be less costly than YBIP water storage development if the market infrastructure were to develop to do so.

In summary, the claim that individual projects within an integrated system cannot be assessed simply does not hold up. Conditional analysis of outcomes from decisions about one of many interdependent projects can be done in an economically meaningful way, and is not contrary to understanding the contributions of individual components to an integrated system.

Yakima Basin Plan Benefits/Costs

Individual Project Contributions

This fact does not negate the concept of Integrated Water Resource Management processes and goals, and I recognize that benefit-cost analysis results are not the only factor that are or should be considered in policy decisions regarding complex economic-environmental systems. However, I am convinced that a clear understanding of the contributions of each project are knowable (or at least legitimately estimable), and are an important part of the body of information useful for such decisions. Indeed, in the context of political process, and even from an economic perspective, the question about what to do when B-C analysis does not support individual components of an integrated plan that might satisfy a B-C test as a whole is a legitimate problem, but it should be confronted head-on rather than by dismissing conditional contributions of each of the components (for pithy comment on this point, *see* Campana (2015) — “References” appear below).

In the last sentence of their article MG state that “A study that disaggregates YBIP actions can help refine future choices... .” I agree with them on this point; except why must we wait for the future?

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Steve Malloch's & Michael Garrity's Response to Jonathan Yoder's Article

Yakima Basin Plan Responses

At the outset, we would like to thank Professor Yoder and his team for their work reviewing the Yakima Basin Integrated Plan (YBIP). To their credit, they thoroughly analyzed a considerable amount of economic, fishery, and hydrological data in a short time period. In responding to the article we produced for *The Water Report*, Professor Yoder offered a vigorous and detailed defense, helping us — being environmental lawyers rather than economists — to better understand the work his team did.

Analysis Ironies

As conservation activists, we are acutely aware of the various ways benefit-cost (B-C analysis) helps to sort out projects that have societal, economic, and environmental merit from those that do not. However, we are also acutely aware of the long history of abuse of B-C analysis in water resources projects. The irony is that typically that abuse is slanted towards justifying projects with enormous unaccounted-for environmental costs. Here, we are in the less typical role of defending enormous accounted-for environmental benefits that are being used to justify a plan that includes new water infrastructure along with major environmental restoration and protection measures.

Unusual Alliance

As has been the case many times in the development of the YBIP, we find ourselves in new and unusual places politically. In this case we are allied with the State of Washington, the US Bureau of Reclamation, the Yakama Nation, irrigation districts, and conservative central Washington counties, which are all also supporting the enormous accounted-for environmental benefits of this project. As environmentalists, we also find ourselves in the unusual position of being “insiders” to a complex process. Our success so far at helping to shape the YBIP to be the innovative and effective program we’d hoped for (while continuing to work with our fellow stakeholders) has given us confidence that the package can and will be improved as it moves forward. Those who see the package and the process as more static — an understandable point of view for those on the outside of a complex process — are less likely to believe there are viable means for addressing the plan’s weaker points.

Ongoing Innovations

YBIP has evolved since the 2011 report on the programmatic concept (which is what the WRC report had to analyze because it is the most recent complete statement and it is what the legislature directed), and it will continue to do so. For example, we expect that the balance among some of the elements of the YBIP will shift over time — especially in the balance between water marketing and surface storage. There is nothing in the YBIP agreement that precludes adaptation and adjustment to evolving political, economic, climatic, or environmental information. In fact, evolution is anticipated, with alternatives for many of the project elements should the initially proposed ones become infeasible. Indeed, the current phasing of the YBIP, which was not contemplated by the 2011 write-up, reflects a major step in this direction. There is great social and environmental value to pursuing adjustments to the plan over time instead of blowing it up because the entire thing is not perfect. Political and social hurdles would instantly cripple any plan designed to meet only environmental or only out-of-stream water supply goals. In other words, criticism of the plan can and should improve it — not destroy it.

Adaptable Process

As Professor Yoder is clearly aware, there are two significant reasons the Washington Water Research Center was asked to do this work by the Washington State Legislature.

Analysis Impetus

First, in developing the YBIP, there was a desire from a minority of the proponents to do a careful analysis of the benefits and costs of each project element; however, the Bureau of Reclamation and the Department of Ecology chose to focus on analysis of the whole plan and defer project-by-project analysis until the elements were ready for authorization or implementation. We agree with the state legislature that the kind of project-by-project review WRC used is a valid lens to apply to the YBIP and inform its implementation. Our difference is in when that review should be done and for which project elements that review is now ripe. Some of the projects WRC reviews have no realistic chance of being authorized for ten to as much as 25 or 30 years in the future, because they are not part of the YBIP’s initial development phase. For the two biggest water infrastructure projects — new or expanded reservoirs at Wymer and Bumping — no one following the issue could claim to be surprised by Yoder’s conclusion that they are not currently economically justified. The 2008 Yakima Basin Storage Study arrived at very similar conclusions. After a series of winters such as that of 2015, with reasonable precipitation but very little snow (conditions consistent with climate model results), and rational economic response in agricultural practices, those big infrastructure projects may or may not be justifiable. To do the analysis now essentially prejudges decisions that will be made ten, twenty, or thirty years from now.

Appropriate Timing

Which is, of course, the second reason. Within the Washington State Legislature, there are skeptics and opponents of water supply infrastructure spending on the east side of the Cascades; Professor Yoder’s analysis helps them make their case.

Opponents’ Purposes

Yakima Basin Plan Responses

Funding Doubts

Overall Benefits

Four Accounts v. WRC Analysis

Sockeye Rebound

Analysis Simplification

Interplay Evaluation Warranted

Marketing Potential

However, the initial development phase of the YBIP is now ripe for careful analysis as it is ready for action in both DC and Olympia to authorize or fund the major elements. (See the initial article in *The Water Report* for a description of the initial development phase, but in brief it includes: fish passage at Cle Elum and Rimrock reservoirs, the Kachess Drought Relief Pumping Plant (KDRPP), and the Keechelus to Kachess conveyance (K2K); as well as water conservation; habitat improvement; water marketing; and groundwater storage; *Yakima River Basin Integrated Water Plan: Strange Bedfellows take Risks, Find Common Ground*, TWR #106, Dec. 15, 2012). For the major elements requiring federal authorization — KDRPP and K2K — that element-specific analysis is being undertaken by the Bureau of Reclamation. As Professor Yoder notes, the WRC study casts doubt on whether those projects as currently envisioned will pass a B-C analysis. If under the Bureau of Reclamation’s analysis one or both of the projects do not pass muster, the prospect of legislative authorization or appropriation for those projects dims.

We also want to reply to several of Professor Yoder’s responses where he makes valid points: **Aggregated v. Disaggregated Analysis**

We agree with Professor Yoder that disaggregation is important as a means to winnow project options and elements to get the best overall outcome. However, for the new model of water planning — “integrated water resources planning and management” — in some circumstances, aggregation may make more sense, especially when, as is almost certainly true for the Yakima, the most beneficial parts of a project simply would never happen without also including elements with less benefit. This is a problem long faced in western water — many multi-purpose water supply projects were justified based on hydropower or flood control benefits. How to fairly and usefully evaluate the new “integrated” projects is a work in progress.

Fishery Benefits

The most stark and important difference between the Four Accounts and the WRC analyses is in the benefit ascribed to fishery restoration. WRC found fishery benefits of only \$1-2 billion compared to the \$5-7.4 billion in fishery benefits in the Four Accounts analysis. While there are several factors in arriving at this smaller number, the most important one is the rate of population growth, especially for sockeye being actively reintroduced to habitat blocked for a century by Bureau of Reclamation dams. For sockeye, the Four Accounts analysis focused on potential colonization of this new habitat, while the WRC analysis notes the difficulty in increasing Columbia Basin salmon populations which are subject to dam passage, river, and ocean condition constraints — even as it concludes that recent salmon population increases in other parts of the Columbia Basin despite those constraints reduce the value of restoring salmon in the Yakima.

Fortunately, with sockeye already returning in surprising numbers to the Cle Elum River due to early efforts by the Yakama Nation, an empirical early population growth rate will be known in a couple of years. (Whether these reintroduction efforts are part of the plan or not is perhaps more a philosophical than factual debate — the Yakama Nation effort predates the Integrated Plan, but it also was implemented in hopes of increasing the likelihood that the YBIP will successfully and quickly fund state-of-the-art fish passage and the associated Cle Elum Reservoir pool raise before a bad drought year highlights the long-term inadequacy of the current crudely designed downstream fish passage system that only works when the reservoir is full).

Also, the WRC report pounces on a simplification made in the Four Accounts analysis: for the level of analysis needed for a programmatic analysis, the Four Accounts analysis ascribed the only the cost of fish passage to sockeye recovery, while all other flow and habitat work was ascribed to the other species. The result was that the cost of sockeye recovery included only the fish passage, and the costs for other salmon species, bull trout and steelhead recovery included only habitat and flow work. Sockeye will need at least some of the flow and habitat work, and the other species will benefit from fish passage. WRC used that simplification and found that fish passage passed a B-C analysis, while the flow and habitat work supporting much smaller numbers of other species, did not.

While we are no more biologists than we are economists, a thorough study of the interplay between habitat restoration, fish passage, and flow improvements is clearly warranted. Water management — including reservoir and groundwater storage, water conservation, and how water markets are pursued and applied — will greatly affect flows and water temperatures, and the studies undergirding the YBIP, let alone the WRC report, have at most only scratched the surface of these interactions.

Water Marketing

We agree with the WRC report that water marketing should be given more weight by the YBIP and in the Yakima basin generally than it has been to date. How far water marketing can go toward addressing the many problems in the Yakima in a socially, economically, and environmentally acceptable manner is an open question, but one that should be explored more thoroughly. In many western basins, market transfers of water are spurred in the first major water short year after a basin adjudication. Given this year’s snowpack, and the all-but-completed Yakima adjudication, we may have those conditions now.

Yakima Basin Plan Responses

Cost Sharing

Irrigators' Share

Constructive Discourse

Who Pays and How Much?

A point of contention is how much the irrigation districts are willing to, or can, pay. The implication from the WRC report is that the irrigation districts should not be willing to pay for the water supply infrastructure in the initial development phase (primarily the Kachess Drought Relief Pumping Plant and a portion of the K2K Pipeline) as they do not pass its B-C analysis test. However, the irrigation districts have publicly stated and inserted language in draft federal legislation that states that they are willing to pay for those projects, with interest, over a reasonable time period. The economic calculus of the WRC and the offer by the irrigation districts are very different. Professor Yoder is correct that signed contracts are more convincing than an offer or draft legislation. On this point, the WRC team might ask whether the irrigation districts have information that was not taken into account in the economic analysis. Similarly, the irrigation districts might reconsider the economic rationality of their offer. Both might consider the shifts in climate already evident in the Yakima Basin and the effects of that shift on crop mix and economics.

If the YBIP is to progress on authorization and funding, leaders in Congress, the state legislature, and the White House Office of Management and Budget will insist on water users paying for their share of water infrastructure, including interest. This is in alignment with the irrigators' stated intent. If it turns out the irrigators cannot afford surface storage, or only a portion of it, critics of the YBIP's surface storage projects will have much less to worry about — the full suite of projects may remain on paper, but they will not be built.

Jonathan Yoder's Response

My interest in this exchange with Malloch and Garrity has been to address and move beyond some persistent assertions about the WRC report that have curtailed what could be a more substantive and constructive discourse about the report itself, the economics of the YBIP, and the debate about the sometimes-uncomfortable role of Benefit-Cost analysis in integrated water resource management. I could quibble with a few of Malloch and Garrity's statements about the WRC report in their final response, but I commend their focus on some of the more substantive and complex historical, political, and methodological issues that remain. I am hopeful that this exchange will improve understanding about the WRC study and to further inform debate and decisions about the Yakima Basin Integrated Plan.

Thank You

for your interest in this

Pre-Publication version of articles which will appear in *The Water Report* #135 (May 15, 2015)

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